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(71) Applicant and
(72) Inventor: PIKE, Anthony, Bruce [GB/GB]; 10 Auckland Close, Upper Norwood, London SE19 2DN (GB).

(74) Agents: BAIN SMITH, Timothy et al.; Raworth Moss & Cook, Raworth House, 36 Sydenham Road, Croydon, Surrey CR0 2EF (GB).

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(54) Title: MEDICAL PROTECTION SHEETING
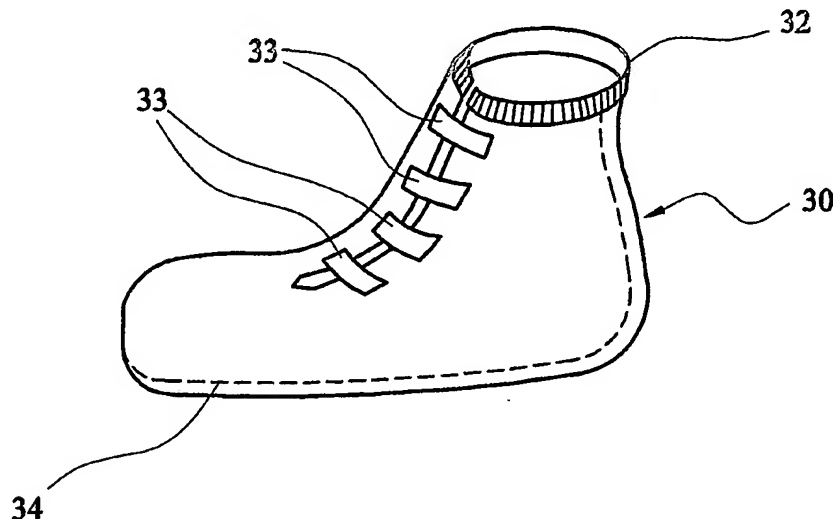
(57) Abstract: A medical protection sheeting in the form of a slip sheet or as a covering for a dressing (30), formed from a low frictional material having a coefficient of static friction substantially the same as its coefficient of dynamic friction.

# MEDICAL PROTECTION SHEETING

The present invention relates to medical protection sheeting
5    useful for patient handling and designed to reduce the risk
of damage to the skin of patients where this is damaged or
where it is subject to pressure.

Patient handling sheeting is known for turning patients or
10   lifting them between beds and trolleys and are sometimes
known as "slide sheets", a term which will be used below.
Where patients are severely injured, the movement between
beds and trolleys can be difficult with known slide sheets
since the material used for slide sheets is such as to cause
15   high initial resistance to sliding, that is, the coefficient
of friction rapidly rises as the sheet is pulled, reaching a
peak before sliding actually commences.  The sheet then, so
to speak, becomes "unstuck".  This sudden release from a
high frictional resistance is the frequent cause of damage
20   to a patient's skin, particularly where this has been burnt
or in other cases where the epidermis is damaged.  In some
cases, this can cause separation of the dermal-epidermal
junction.

25   Even where the epidermis is not initially damaged, decubitus
ulcers or bedsores can form due to reduced blood flow in a
local area of skin slowing because of pressure.    By
frequently changing body positions, this problem can be
solved.
30

Further problems occur with dressings which rub on bedding
or clothing.  Again, high frictional coefficient between the
dressing and material with which it is in contact can cause
rucking of dressings and again epidermal damage.
35

According to the invention, there is provided medical
protection sheeting formed from a low frictional material

having a coefficient of static friction substantially the same as its coefficient of dynamic friction.

The advantage of such a material is that as the material just starts to move over an adjacent material, which where possible is the same material, there is a smooth and gentle initiation and acceleration with no jerking. Thus epidermal damage is limited. Where slide sheets are made of the material of the invention, there is also less energy required by those caring for the patient. Where there is a concern for bedsores, then the patient may himself be able to move alternatively and again less energy may be used by carers to frequently move the patient lying on the material.

Preferred materials have a coefficient of friction less than 0.4.

Preferably the material is a woven fabric to enable a certain amount of "breathing". The material should not be too coarse and it is considered that materials having a linear density of 1000 to 40 decitex should be satisfactory. Materials of 470, 350 and 50 decitex have been tried and perform well. The materials weigh respectively for the 350 and 50 decitex material 180 and 61.7 $gm/m^2$. The finest material used which performed well under test was DuPont Tactel (RTM) having nylon warp yarn 50F15T143 and nylon weft yarn 50F15T1943. A coarser fabric identified as 470T743 has been used with success. A medium weight fabric identified as DuPont's 350T749 was successfully used.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings and diagrams in which:-

Figure 1 is a diagram of a test rig to test materials for the invention;

Figure 2 shows test results from the rig of Figure 1 to compare material according to the invention with linen so as to indicate relative coefficients of friction;

5    Figure 3 is an extract from the results of Figure 2;

Figure 4 is a set of test results from the rig of Figure 1 showing how varying the relative orientation between samples of the same material according to the invention varies the
10   friction between the samples; and

Figure 5 shows a bootee made with material according to the invention.

15   Samples of DuPont (DTI) plain woven nylon fabric from which slide sheets and dressing covering were made and were tried out as follows:-

| Parafricta (TM) Ref | DTI Ref | Linear Density (decitex) | Weight g/m$^2$ | Gauge mm | Finished Threads per cm | Tensile Strength kN |
|---|---|---|---|---|---|---|
| P470 | 470T743 | 470 | | 0.4 | 24 x 20 | |
| P350 | 350T749 | 350 | 180 | <0.35 | | >2.3 |
| P50 | 98Wext/4 | 50 | 61.7 | 0.15 | 61x47 | 6* |

20
*Shear strength kN/m$^2$

Samples of P470 fabric were submitted to the test rig shown in Figure 1 for the purpose of comparing its performance
25   with linen on a linen to linen basis, P470 to P470, P470 to linen and linen to P470.

A block on flat measurement technique was used (Figure 1). A 50 x 50 mm sledge S wrapped in test fabric T1 was pulled
30   over a flat plate F which was covered by a sheet of the second fabric T2 to be tested. The sledge was pulled at a

constant speed of 1 mm per second using a steel wire and a
pulley by an Instron mechanical testing system LC. The load
that was needed to pull the sledge gives the friction load
and was recorded throughout the test. The sledge was loaded
5    by weights giving a 40 N vertical load during the test. The
friction coefficient is calculated as the frictional force
divided by the applied load.

The results are shown schematically in Figure 2, with the
10   main features given in Table 1. The highest friction values
were recorded for the linen rubbing against linen where the
static friction coefficient was 0.67 and the dynamic
friction coefficient was 0.44. By contrast the static
friction coefficient and dynamic friction coefficient were
15   about 0.2 for the P470 rubbing on itself. When P470 was
rubbing on linen, or linen on P470, the results were very
similar with a dynamic friction coefficient of about 0.3
with a slightly higher static friction coefficient. Figure
3 extracted from Figure 2 shows that static friction
20   increases rapidly from the application of a load until linen
stretches. The linen then suddenly starts to slide, at
which point the dynamic friction decreases rapidly.

Table 1, Main Results

25

| Figure 2 Trace | Sledge Fabric (T1) | Flat Fabric (T2) | Static Friction | Dynamic Friction |
|---|---|---|---|---|
| 12 | Linen | Linen | 0.67 | 0.44 |
| 11 | P470 | P470 | 0.19 | 0.21 |
| 13 | P470 | Linen | 0.38 | 0.33 |
| 14 | Linen | P470 | 0.33 | 0.29 |

Having completed the comparative tests of P470 against
linen, a second series of tests was conducted to determine
30   the effect of relative orientation as between warp and weft

of P470 material.  The same rig (Figure 1) was used as in
the first series of tests.

In the first set of the second series of tests, the load was
recorded by chart recorder and then scanned and digitised to
obtain digital results.  For the second set of measurements,
the load was recorded directly by a data logging system in a
digital form.

The results are shown schematically in Figure 4, with the
main features given in Table 2.  The highest friction values
were recorded for the linen rubbing against linen where the
static friction coefficient was 0.67 and the dynamic
friction coefficient was 0.44.  By contrast, the static
friction coefficient and dynamic friction coefficient were
about 0.2 for the P470 rubbing on itself.  When P470 was
rubbing on linen, or linen on P470, the results were very
similar, with a dynamic friction coefficient of about 0.3
with a slightly higher static friction coefficient.  There
was very little difference between the friction results for
all the P470 on P470 tests.

The uncertainty of measurements of this type has not been
studied definitively, but general experience of friction
measurements would suggest that at an average friction level
of about 0.2, the uncertainty in friction coefficient
measurement is about 0.03.

Table 2, Further Results.  Across is the direction on the
P470 fabric parallel to the weft on the sample supplied.
Along is perpendicular to this and parallel to the warp.

| Figure 4 Trace | Sledge Fabric T1 | Flat Fabric T2 | Static Friction | Dynamic Friction |
|---|---|---|---|---|
|  | Linen | Linen | 0.67 | 0.44 |
| 24 | P470 – Along | P470 – Along | 0.19 | 0.21 |

| | P470 – Along | Linen | 0.38 | 0.33 |
|---|---|---|---|---|
| | Linen | P470 – Along | 0.33 | 0.29 |
| 21 | P470 – Along | P470 – Across | 0.24 | 0.24 |
| 22 | P470 – Diagonal | P470 – Across | 0.21 | 0.21 |
| 23 | P470 – Across | P470 – Across | 0.23 | 0.23 |

Trace 21 marked "crossed" on Figure 4 indicates the Sledge
and Flat fabrics are orientated warp to weft or
Along/Across.

The comparative second series of tests showed that the P470
material was best aligned to another sample of itself so
that both the warp threads were parallel, that the movable
sheet was pulled in the warp direction and remarkably that
the static friction was slightly less than the dynamic
friction. The most unfavourable relative orientation was
when the P470 materials were warp to weft or "crossed".
However, as long as P470 was arranged to slide on P470,
there was no great difference in the coefficient of friction
for any relative orientation. In none of the relative
orientations was there any great difference and most had the
same static and dynamic coefficient of friction. This
showed that unlike the linen on linen case shown in Figure
3, there was no tendency for sudden jerking when using P470
to P470 in juxtaposition. Sudden jerking would result in
sudden uncontrolled motion.

Although it is desirable to use P470 to P470, the results of
the tests of P470 to linen show that this is considerably
better than using linen to linen. Furthermore, when using
P470 to linen, it is best to pull the P470 in the warp

direction when on linen. It is therefore preferable when making a slip sheet (often about 120 x 70 cm or 145 x 72 cm) to cut the material so that the long side of the sheet runs parallel with the weft. Obviously, a range of sizes may be

5   supplied up to about 200 cm long and up to 100 cm wide.

It will be observed that when using the material of the invention as a slide sheet, the force F to pull the sheet under a patient of weight W, the force required where $\mu$ is

10  the coefficient of friction and g is the acceleration due to gravity, that $F = 2\mu gW$, where static $\mu$ ($\mu s$) is much greater than dynamic $\mu d$, then F is increasingly greater to start moving the patient. Generally it can be shown that the material of the invention requires only about half the

15  effort (F) when compared to a sliding linen over linen.
Also, the material can be made strong for any given weight of material.
Generally, $\mu s$ should be no more than 20% greater than $\mu d$ and both should be less than 0.4.

20

When using the material of the invention as a covering for a dressing, for example, as shown in Figure 5 which is in the form of a bootee 30 with a Lycra (RTM) collar 32, adjustable Velcro (RTM) closers 33 and externally seamed 34, a finer

25  material such as P50 is preferred. Other forms (not shown) of covering for dressings are provided but which are also shaped to other particular parts of the body. The bootee can have its toe cut off to allow ventilation.

30  A particular application of the covering according to the invention is to protect dressings comprising advanced materials such as hydrocolloids which could include active materials to protect against infection or promote healing. Although these dressings may be more expensive than

35  conventional dressings, the protection given by the covering of the invention enables these advanced dressings to remain in place longer. Therefore cost savings ensue.

## CLAIMS

1. A medical protection sheeting formed from a low frictional material having a coefficient of static friction substantially the same as its coefficient of dynamic friction.

2. A protection sheeting as claimed in claim 1 wherein the material has a coefficient of friction less than 0.4.

3. A protection sheeting as claimed in claim 1 or 2 wherein the material is woven.

4. A protection sheeting as claimed in any of the preceding claims wherein the linear density of the material is between 1000 and 40 decitex.

5. A protection sheeting as claimed in claim 4 wherein the linear density is 470, 350 or 50 decitex.

6. A protection sheeting as claimed in claim 4 or 5 wherein the weight of the material is between 200 and 50 $gm/m^2$.

7. A protection sheeting as claimed in claim 4 wherein the material's weight is 180 $gm/m^2$ for the 350 decitex material and about 62 $gm/m^2$ for the 50 decitex material.

8. A protection sheeting as claimed in any one of claims 1 to 7, formed as a bootee with one or more layers of the material.

9. A protection sheeting as claimed in claim 8 wherein the bootee is formed without a toe.

10. A medical protection sheeting substantially as described hereinbefore in any one of its forms and/or in the
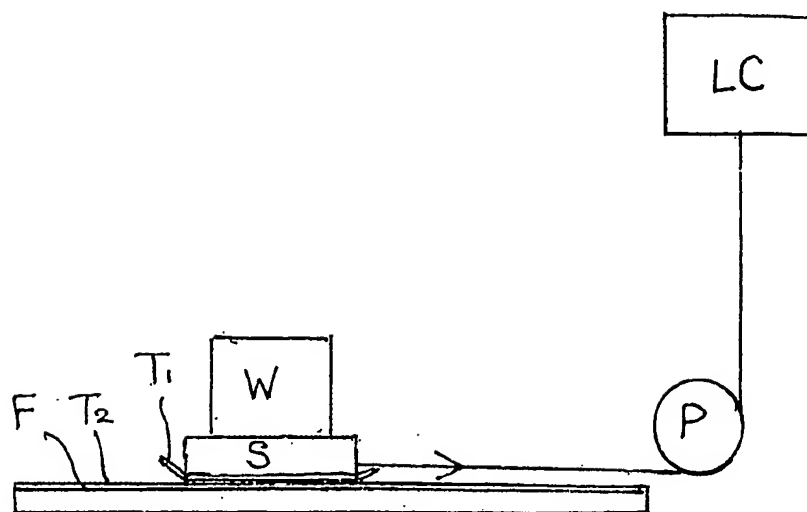
form shown in Figure 5 of the accompanying drawings.
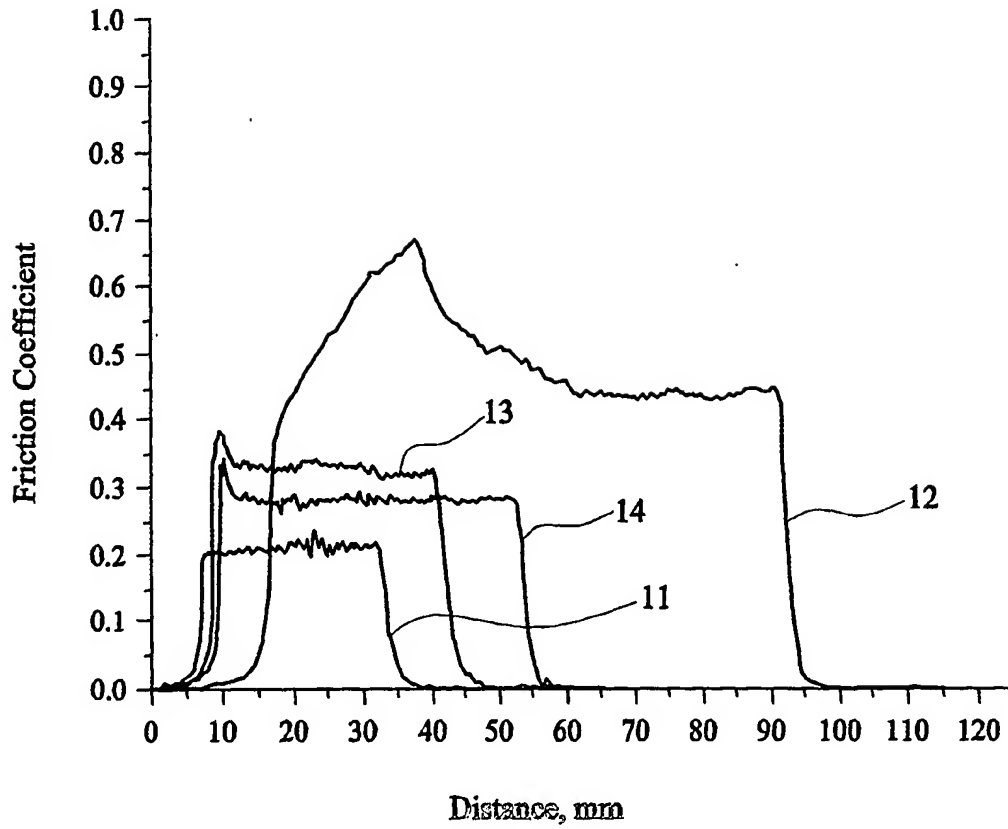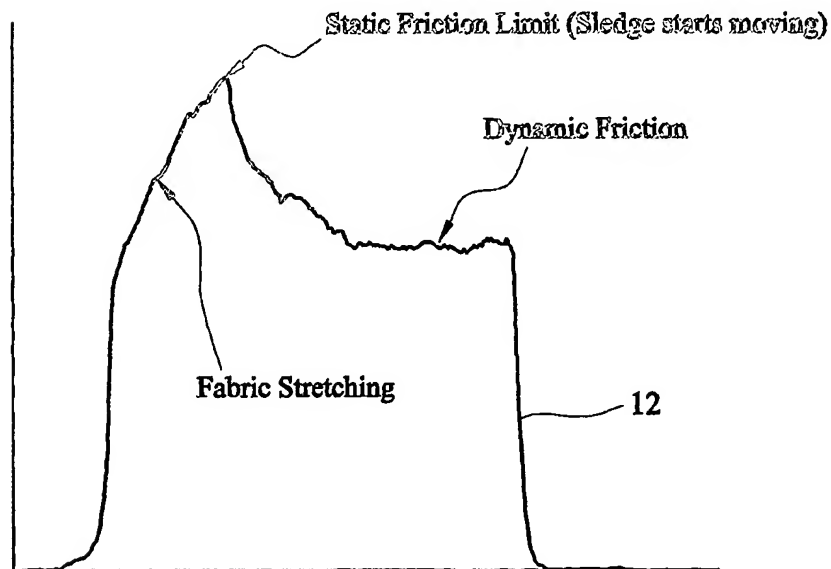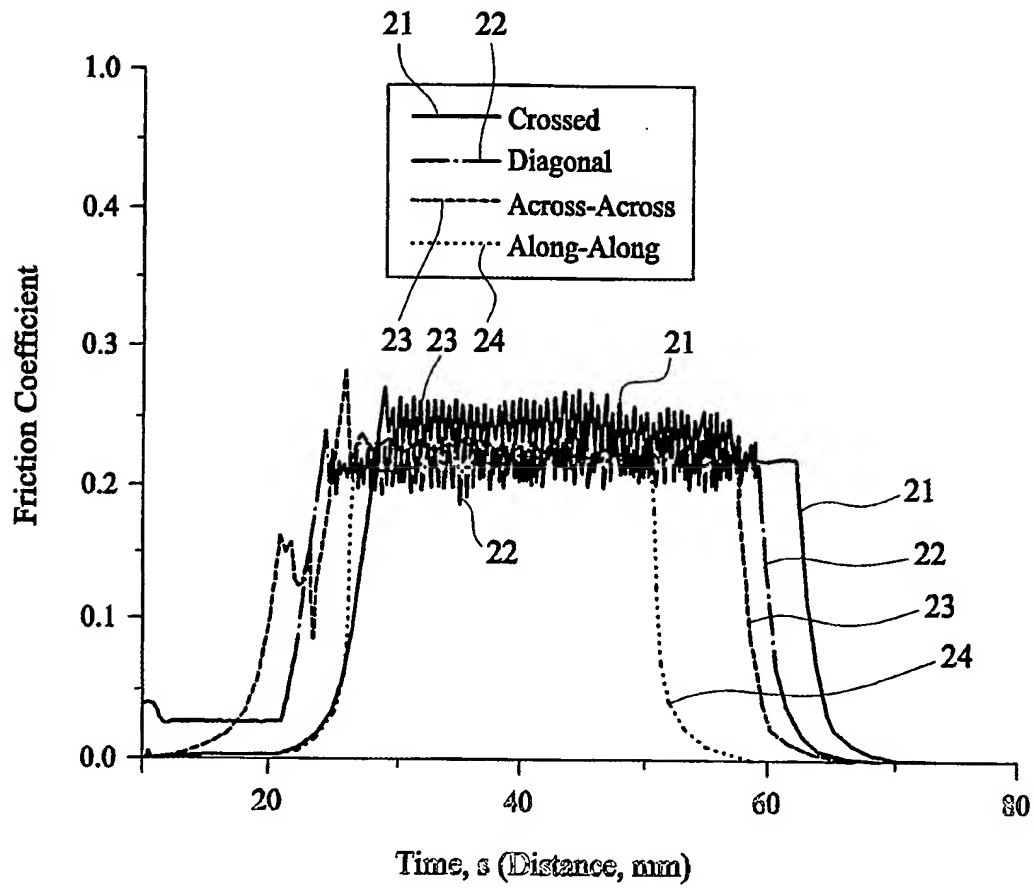
Figure 1

FIG.   2



FIG.   3

FIG. 4



FIG. 5